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POLLUTION OF SLOCUM CREEK, HAVELOCK
NORTH CAROLINA

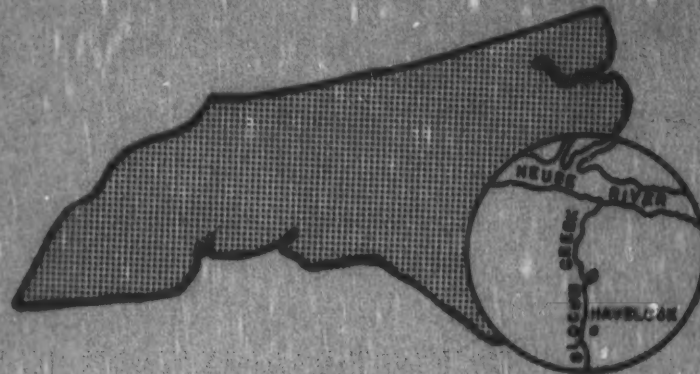
A COOPERATIVE INVESTIGATION BY THE STATE
OF NORTH CAROLINA, DEPARTMENT OF THE NAVY
AND THE FEDERAL WATER POLLUTION
CONTROL ADMINISTRATION

NATIONAL FIELD INVESTIGATIONS CENTER
CINCINNATI, OHIO

NOVEMBER 1969

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POLLUTION OF SLOCUM CREEK

HAVERLOCK, NORTH CAROLINA

REPRODUCED BY
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POLLUTION OF SLOCUM CREEK
HAVELOCK, NORTH CAROLINA

WITHDRAWN
AUG 19 1975

A Cooperative Investigation by the
State of North Carolina
Department of the Navy
and the
Federal Water Pollution Control Administration

by

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National Field Investigations Center
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Cincinnati, Ohio
November 1969

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Personnel of the Public Works Department of the Department of the Navy provided engineering drawings of facilities and operating procedures, space and services for the two mobile trailers, and material and labor for sampling gear and assistance in operation of the Pollution Abatement Plant.

The Special Services of the Marine Corps provided boats, motors, service and dockage for the stream survey.

The State of North Carolina conducted an investigation of the Havelock area, prepared Appendix A, and provided a boat and motor.

The Middle Atlantic Region of FWPCA assisted in the stream survey and the operation of the Pollution Abatement Plant.

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SUMMARY

Slocum Creek fed by two tributaries, the East and West Prongs, flows into the Neuse River downstream from New Bern, Craven County, North Carolina. The Neuse River in turns flows into Pamlico Sound.

The Town of Havelock, North Carolina and the Marine Corps Air Station (MCAS) discharge wastewaters to Slocum Creek and its tributaries. MCAS includes a Naval Air Rework Facility (NARF) for the overhaul and repair of aircraft. NARF consists of two principal divisions, Air Frame and Power Plant. The Public Works Department of the Navy operates utilities for MCAS and Slocum Village as well as a Pollution Abatement Plant for the treatment of wastewaters for NARF.

The highest use of the Neuse River in the vicinity of Slocum Creek was bathing. The highest use of Slocum Creek and its tributaries recognized by the State of North Carolina, was fishing. Unofficially the lower part of Slocum Creek was used for water skiing.

In late September 1968, the State of North Carolina investigated the sources of stream pollution in the Havelock area. From September 24 to October 1, 1968, a stream survey was conducted on Slocum Creek and its tributaries, and from September 30 to October 5 an industrial waste survey was conducted at the NARF operations by FWPCA. In early December the Pollution Abatement Plant was operated by FWPCA personnel.

During the surveys, wastewaters were not being treated satisfactorily and the effluents interfered with the best use of receiving streams. The discharge of oxygen demanding material in all wastewaters was particularly severe, depleting the dissolved oxygen to less than 3 mg/l except in Tucker Creek and at the mouth of Slocum Creek. These concentrations were too low to sustain fish or desirable fishfood organisms. Toxic materials discharged to the East Prong had made the stream bottom devoid of visible life. Halocarbons may have been at high enough concentrations to cause fish flesh tainting. The water discharged to the Neuse River from Slocum Creek was not detrimental to the best uses of the Neuse.

Wastewaters from NARF contained oxygen demanding materials, phenol, and halocarbons, predominantly from the aircraft paint stripping operations of the Air Frame Division.

CONCLUSIONS

1. The East Prong was a sluggish stream with little capacity to assimilate polluttional material.
2. The polluttional load discharged to the East Prong from Slocum Village Sewage Treatment Plant averaged 120 pounds per day of BOD₅ (5-day biochemical oxygen demand) and interfered with highest use of the streams.
3. The NARF Pollution Abatement Plant discharged about 280 pounds per day of BOD₅ to Sandy Branch, a tributary of the East Prong, and also interfered with highest stream uses. It was hydraulically overloaded and only provided chemical treatment for the highly variable waste loads from NARF. At best, it might have provided a 5 percent reduction in the oxygen demanding load from NARF.
4. The Station (MCAS) Sewage Treatment Plant discharged an average of 870 pounds per day of BOD₅ to Slocum Creek, after only reducing the BOD₅ by 73 percent. The plant cannot be expected to provide an adequate degree of treatment for the best water use of Slocum Creek because the trickling filters are too small.
5. The dissolved oxygen levels in the streams were less than the State specified minimum of 3 mg/l for all stations except Tucker Creek and the mouth of Slocum Creek. Except for the

named stations, the D.O. levels would not support fish or desired fishfood organisms.

6. The heavy metals, cyanide, and phenol were not found in concentrations that can be stated to be harmful to aquatic life within the stream.
7. In Slocum Creek, bacterial pollution was less than the State water quality standards specified maximum limits for fecal coliform of 5,000 MPN/100 ml.
8. The concentrations of halocarbons found in the streams (1 to 1.4 mg/l) can be suspected of causing tainting of fish flesh.
9. Bottom samples collected from the East Prong, between the Slocum Village Sewage Treatment Plant and Sandy Branch, indicated toxic or otherwise inhospitable conditions within the bottom sediments for aquatic life.
10. The sight and smell of the East Prong and Slocum Creek was offensive.
11. During the survey the water entering the Neuse River from Slocum Creek was not detrimental to the best water uses on the Neuse.
12. Many flows discharging to the pollution abatement sewer were not shut off when the water was not needed. Water use was excessive.
13. Eighty percent of the NARF waste organic chemicals were from the Air Frame Division, particularly from the stripping of

paint from aircraft. The balance was from the Power Plant Division.

14. The load of phenols to Sandy Branch from the Cleaning Shop and the aircraft stripping operations in the Air Frame Division varied from none to 300 pounds per day.
15. Most of the 120 pounds per day of dispersed oily wastes were from the Engine Preclean operations.
16. The greater concentrations (1 to 3 mg/l) of halocarbons were from the Engine Preclean and the aircraft paint stripping operations.
17. The waste control of spent plating and cleaning baths was very good. Small amounts of metals were lost from the plating shops as drag-out.
18. The discharge of oily wastes from Air Base Operations to the storm drain was not evident during the survey. Jet fuel was being lost to the sanitary sewers.
19. The proposed Industrial Waste Treatment Facility was found to be inadequate for the water pollution control needs of NARF wastewaters.
20. The sewer system and sewage treatment plant for the Town of Havelock went into operation in November 1968, and should provide a solution to the problems of presently unsewered wastewaters in the incorporated area.

RECOMMENDATIONS

It is recommended that:

1. Wastewater originating in the Cleaning Shop in building 137 be diverted from the storm sewer to the pollution abatement sewer.
2. Water meters be installed on process water lines for each department of NARF.
3. Dry stripping of aircraft be considered.
4. Floor drains in pits under plating and cleaning tanks be plugged.
5. In spent baths, cyanides be destroyed, hexavalent chromium be reduce to trivalent, heavy metals be precipitated and the sludges be buried at an elevation not subject to ground water leaching.
6. A floating boom to collect oil for skimming be placed across the cove that receives cooling water from the Electric Generating Plant.
7. Surface erosion from the land disposal site be stopped.
8. Lime sludge from the water treatment plant not be discharged to Slocum Creek.
9. Light oils such as jet fuel skimmed from primary clarifiers at the Station Sewage Treatment Plant not be discharged to digesters.

10. The disinfection of the effluent from the Station Sewage Treatment Plant be improved for the protection of service personnel who water ski on Slocum Creek.
11. The degree of treatment provided by the Station Sewage Treatment Plant be improved to ensure compliance with the water quality standards assigned to Slocum Creek, and the MPN of fecal coliform in the effluent not exceed 200/100 ml.
12. The Department of the Navy make feasibility studies for the economical treatment of wastewaters from NARF, Slocum Village and MCAS, to the degree required to meet the water quality standards assigned to Slocum Creek and its tributaries.
13. The Department of the Navy immediately plan and construct those facilities for which funds are available and prepare plans and financing for the balance of the required treatment facilities.
14. The Town of Havelock give consideration to providing a holding pond in the future for additional treatment of the effluent from its treatment plant.

INTRODUCTION

AUTHORIZATION

Following a meeting at the Marine Corps Air Station (MCAS), Cherry Point, North Carolina, August 28, 1968, the Middle Atlantic Region of FWPCA requested the Technical Advisory and Investigations Branch (now National Field Investigations Center) to conduct an intensive survey of the MCAS waste treatment facility and the effects of the discharges on water quality. This survey and study was in accordance with the provisions of the Water Pollution Control Act and Executive Order 11288.

OBJECTIVES

The objectives of the study were to:

1. Determine waste treatment plant efficiencies and effects of effluents on water quality in Slocum Creek and the possible effect on the Neuse River.
2. Investigate industrial waste sources at Naval Air Rework Facility and determine methods to minimize waste flows and concentrations before reaching industrial waste treatment facility.
3. Determine immediate action plans to provide maximum treatment for all wastes at the Marine Corps Air Station.
4. Investigate all waste sources in Havelock area and advise community of need for treatment of uncontrolled waste discharges.

5. Review and evaluate proposed industrial waste treatment expansion plans and make recommendation on present and future waste treatment needs for Naval Air Rework Facility.

SAMPLING AND INVESTIGATION DATES, 1968

Activity	
Eckman dredge samples from Slocum Creek	Sept. 12
Stream and sewage treatment plant samples	Sept. 24-Oct. 1
Industrial waste samples	Sept. 30-Oct. 5
Dye tracer studies	Sept. 24-29
Investigation of ground disposal site	Sept. 23-26
Investigation of Havelock area	Sept. 23-27
Core samples from Slocum Creek	Oct. 4
Pollution abatement plant operated and sampled	Dec. 3-13

DESCRIPTION OF THE AREA

The Location Map (Fig. 1)* is a part of the Havelock quadrangle, USGS map, 7.5 minute series, 1949, including the Marine Corps Air Station and the Civilian Area adjacent to Slocum Creek. Figure 2 schematically relates the stream survey sampling stations to the major wastewater discharges.

SLOCUM CREEK AND NEUSE RIVER

The "Prongs" (East Prong and West or Southwest Prong) which are the headwaters of Slocum Creek have been described as swamp waters: "Such waters are characterized by high color, low pH and dissolved oxygen, due to decay of organic substances, and sluggish flow. The flushing of swamps during periods of continuous or intensive rainfall may affect seriously receiving waters of otherwise good quality. Where the receiving waters are bordered by swamps, the effects of swamp water are intensified."^{1/} The swamp waters are also characterized by containing less than 500 mg/l of chloride ion.

Slocum Creek excluding the "Prongs," but including Tucker Creek, is characterized as tidal salt waters,^{1/} generally having a natural chloride ion content in excess of 500 mg/l. Slocum Creek downstream from the mouth of Tucker Creek has been designated as commercial fishing water.^{1/}

^{1/} State Stream Sanitation Committee, Pollution Survey Report No. 7, The Neuse River Basin, North Carolina State Board of Health, 1959.

*Figure 1 is a "fold-out" in the back of the report.

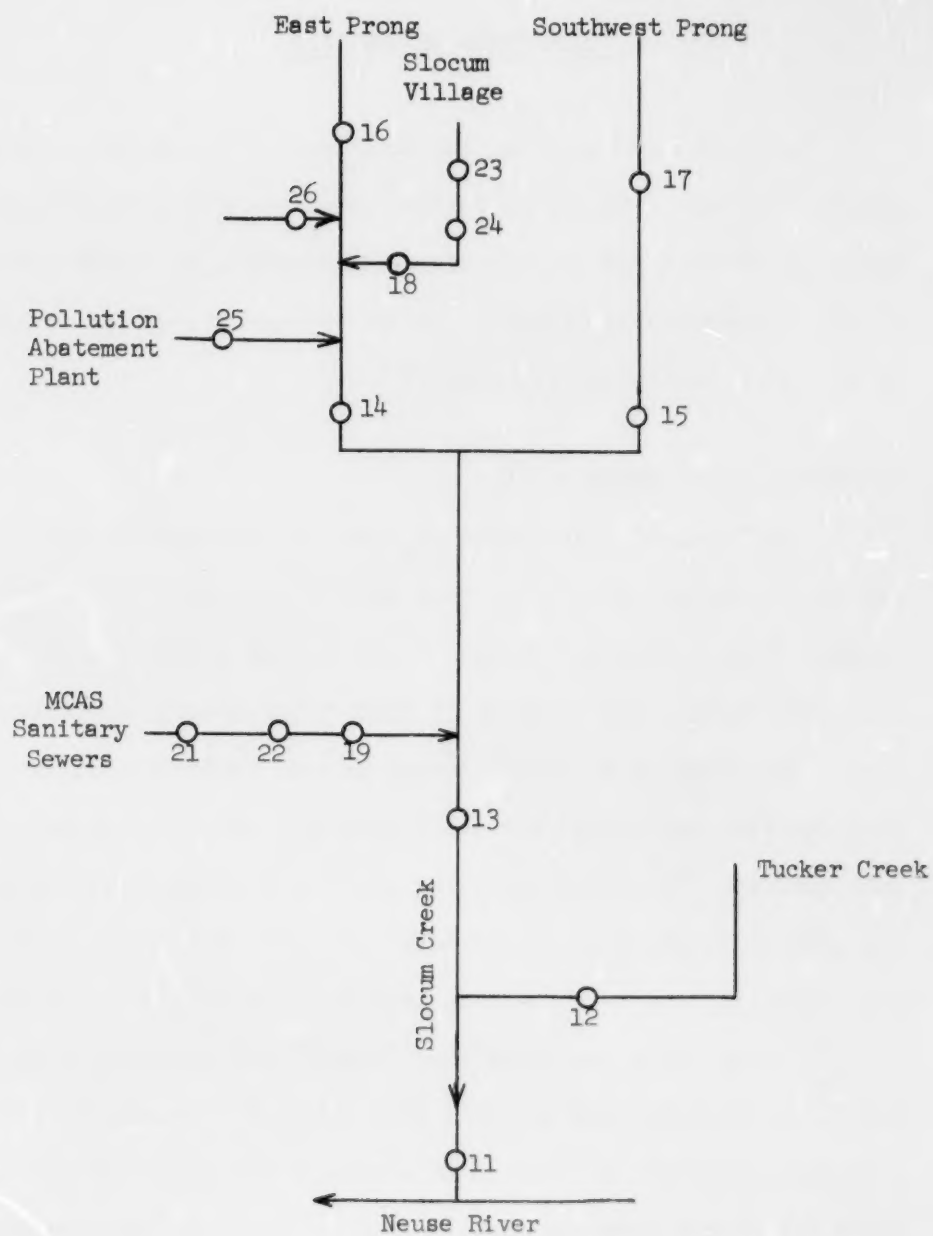


Figure 2

SCHEMATIC LOCATION OF STREAM SURVEY STATIONS
MCAS

"NCO [Non-Commissioned Officers] Club at Cherry Point Marine Air Station has a small beach on Slocum Creek which is used as a base for water skiing but is restricted as to public bathing. Samples taken [1956] approximately 1,000 feet downstream from the club contain an average of 81,000 [MPN] coliform bacteria per 100 ml. This is considerably higher than that considered safe for outdoor bathing which is generally associated with water skiing. A constant public health hazard is posed by three sewage treatment plants and an industrial waste plant located within five miles of the beach. The station sewage treatment plant, three miles upstream, is well operated and has facilities for chlorinating the effluent. Approximately two miles further upstream are the treatment plants of two housing developments, one an overloaded secondary plant without chlorination, and the other a poorly operated primary plant without chlorination. The chemically treated industrial waste from the airplane repair shops is discharged to the stream just below these two domestic sewage plants. It will be extremely difficult if not impossible, to protect the area used for water skiing even under the best of conditions and the use of Slocum Creek for such a purpose should be prohibited."^{1/}

The reach of the Neuse River into which Slocum Creek discharges is designated for commercial fishing and there are five public bathing areas within this segment. The principal sources of pollution are the New Bern area and the discharges from Slocum Creek. The next downstream reach of the Neuse River is designated for commercial fishing and shellfishing.^{1/}

"Pamlico Sound, into which Neuse River flows, is the largest expanse of water in the State. The sound is separated from the ocean by the outer banks, with access to the ocean gained by three

inlets, all of which are shallow. The lunar tide on the sound is negligible; therefore, any tidal changes would be due to wind action. During the study [1956] a tidal range of up to 4.5 feet was found at New Bern."1/

MARINE CORPS AIR STATION

The Marine Corps Air Station, Cherry Point, North Carolina, was commissioned in 1942. The Air Station is located on 11,360 acres in Craven County, between Morehead City and New Bern. The Air Station provides 52,000 feet of runways to handle all types of high performance aircraft.

Headquarters for Marine Corps Air Base, Eastern Area, are located here, as well as headquarters for the Second Marine Aircraft Wing, and are referred to as Air Base Operations in this report. The Naval Air Rework Facilities (NARF), a Marine Corps service, provides major air frame and power plant overhaul and repair (O&R) service as well as emergency repairs for aircraft. The Department of the Navy, Public Works Department, constructs and operates the utility services of the Air Station, including a pollution abatement plant to treat industrial wastes produced by NARF.

CIVILIAN AREA

The description of the civilian area is summarized from "Report of Wastewater Treatment Conditions in the Havelock, North Carolina Area" (Appendix A).

Town of Havelock

The Town of Havelock is a residential and retail business area situated between the East Prong and the Southwest Prong. The 1960 Census reported a population of 2,433 persons. For purposes of this report, three areas are defined within the corporate limits: Havelock Park, a shopping center complex west of U.S. highway 70, and a mobile home park with several adjacent retail businesses.

Slocum Village

Slocum Village, adjacent to Havelock Park, is not defined in Appendix A because the utilities were being operated by the Public Works Department of the Department of the Navy. Slocum Village is a subdivision of homes for married military personnel assigned to the Marine Corps Air Station.

Unincorporated Area

A commercial laundry is located about 0.5 miles north of Havelock on U.S. highway 70.

TRACER STUDIES

The flow patterns of Slocum Creek and the Prongs were investigated and are reported in Appendix B (Dye Tracer Study of Slocum Creek). Dye injected at Sandy Branch, where the NARF industrial wastes entered the East Prong, first reached the foot bridge (Sta. 14, Fig. 1) in nine hours and most of it arrived in 22 hours. The dye was stratified in a surface layer. The East Prong was a sluggish stream, better defined as a lagoon for pollution reporting purposes. This same dye injection appeared in the Southwest Prong the following day and disappeared slowly in a matter of days. Wastewaters discharged in one prong could appear in the other and both prongs were very sluggish at the time of the investigation.

Dye was subsequently injected in the effluent line of the Station Sewage Treatment Plant ("Sewage Disposal" or Sta. 22, Fig. 1). After four hours the dye was well dispersed across Slocum Creek and was found upstream and downstream from the point of effluent discharge to the creek. After 24 hours the dye had disappeared.

WATER USES

RECEIVING STREAMS

Neuse River

Appendix A indicates that the segment of the Neuse River to which Slocum Creek is tributary is classified, as to its best usage, for bathing and any other tidal salt water usage except shellfishing for market purposes.

Slocum Creek

In Appendix A, Slocum Creek is classified for fishing and any other tidal salt water usage except bathing or shellfishing for market purposes. In practice the Special Services boats from the NCO marina were limited to that part of Slocum Creek from Slocum Bridge to the mouth. Water skiing was observed in this area, particularly the lower part. Fishing for flounder and crabs was reported.

The Prongs

The two prongs and the tributaries to the Southwest Prong are classified in Appendix A for fishing and any other use except for bathing or as a source of potable water supply. Of these uses, only fishing was prevalent. The tributaries of the East Prong, such as Sandy Branch, are classified for agricultural, industrial cooling and processing water supply, and fish survival.

STANDARDS

State Water Quality Standards

For all waters considered in this report the pH values were limited to the range 4.3 to 8.5. These waters were classified as swamp waters, a pH less than six was permitted. For all of these waters the dissolved oxygen must not be less than 3 mg/l.

In the reach of the Neuse River considered in this report the fecal coliform shall not exceed 200 per 100 ml (MPN or MF) in five consecutive samples. In Slocum Creek the fecal coliform shall not exceed 5,000 per 100 ml in five consecutive samples. There was no limit specified for the Prongs.

The other pertinent criteria involve toxic wastes, oils, deleterious substances, and colored or other wastes. For the tributaries to the East Prong these types of wastes are limited to only such amounts as not to render the waters unsuitable for agricultural, industrial cooling, navigational, fish survival, or cause offensive conditions. For all the other waters considered in this report, toxic wastes, etc., are limited to such amounts, that which alone, or in combination with other substances or wastes, will not render the waters injurious to fish and wildlife or adversely affect their palability, or impair the waters for any other best usage established for this class of waters.

Effluent Standards

Section 4(e) of Executive Order 11288 provides an effluent standard for Federal facilities, with the order that "No waste shall be discharged into waters if it contains any substances in concentrations which will result in substantial harm to domestic animals, fish, shellfish, or wildlife, if methods of treatment or disposal are available that will remove or render harmless such pollutants"

WASTE SOURCES

CIVILIAN AREA

The information on waste sources in the civilian area is summarized from Appendix A.

Sub-soil Disposal

"The larger portion of wastewater (within the corporate limits of the town of Havelock) is disposed of by means of septic tank-nitrification line systems. The soil is in some instances incapable of absorbing the wastewater. . . Outside the corporate limits . . . several mobile home parks and housing subdivisions are served by individual septic tank-nitrification line systems; however, investigation indicated that these systems would not constitute a significant pollution problem on Slocum Creek."

Southwest Prong

The main shopping center complex west of Highway 70, including a coin operated laundry and restaurant, had its sanitary sewers connected to a storm drain discharging to a tributary of the Southwest Prong.

Wastewaters from a mobile home park and several adjacent retail businesses were treated in a secondary type aeration waste treatment plant and discharged to the same tributary of the Southwest Prong. The estimated biochemical oxygen demand (BOD_5) was less than three pounds per day.

An estimated 5,000 gpd (gallons per day) of commercial laundry wastewaters were discharged to the lower portion of the Southwest Prong.

All of these sources of waste were discharged to the Southwest Prong between stations 15 and 17 (Fig. 2) and their effect on the stream was monitored during the survey.

East Prong

During the period of the stream survey the raw sewage load discharged from Havelock Park was estimated to be 75 pounds per day of BOD_5 . This discharge to the East Prong was located about 2,500 feet downstream from North Carolina Highway 101. The Slocum Village sewage treatment plant effluent (Station 18) was discharged to the East Prong, a short distance upstream from the Havelock Park outlet.

MARINE CORPS AIR STATION

The sewage treatment plant and industrial waste data collected between September 24 and October 5, 1968, are presented in Appendix D, tables D-15 through D-28.

Public Works Department

Slocum Village Sewage Treatment Plant

The Slocum Village Treatment Plant was maintained and operated by the Public Works Department. It was an extended aeration plant with postchlorination but without detention tanks. During the period of the survey the effluent (Sta. 24) contained an average 120 pounds per day of BOD₅.

Station Sewage Treatment Plant

The sewage treatment plant for MCAS was located in the area marked "Sewage Disposal" in Figure 1. The plant was a conventional trickling filter plant with sludge digesters and pre- and postchlorination. During the period of the survey the effluent contained an average of 870 pounds per day of BOD₅.

Pollution Abatement Plant

The Public Works Department maintained and operated a chemical waste treatment plant to treat the wastewaters from NARF. The effluent from this treatment plant was identified as the discharge at Station 25 on Sandy Branch, a tributary of the East Prong (Figure 1). During the period of sampling, September 30 to October 5, 1968, the effluent was analyzed for BOD₅ but the results were inconclusive because of the indicated toxicity of the wastes. The COD (chemical oxygen demand) averaged 400 pounds per day. Based on some limited BOD₅ determinations during December 1968, the BOD₅ in September was estimated to be 280 pounds

of BOD₅ per day. This value is not valid for design purposes.

Storm Drainage

A storm drainage system received industrial wastes from NARF and Air Base Operations and was sampled at Roosevelt Road (Station 26). The BOD averaged 45 pounds per day.

Water Treatment Plant

The Public Works Department maintained and operated a potable water supply treatment plant from which waste sludge was discharged to Slocum Creek in the vicinity of the Station Sewage Treatment Plant.

Ground Disposal

The investigation of the ground disposal site is summarized in Appendix C. The primary potential water pollution problem is the erosion of the site and transport of solid wastes to Slocum Creek. A second potential is the possible long time leaching of water-soluble salts placed in the fill.

Electric Generating Plant

The Public Works Department operated an electric generating plant on a stand-by basis. The plant cooling water discharge point was located in a cove directly south of Station 13, Figure 1. In transferring bunker C fuel oil from storage to furnace feed tanks there have been oil spills to the cove.

Naval Air Rework Facility

The overhaul and repair of aircraft at NARF was a job-shop operation as compared to continuous production. NARF was capable of overhauling and repairing several models of aircraft. More than one model of aircraft was in the facilities at one time and other models had not been received for overhaul and repair for a long time. It was not possible to establish an average daily pollutional load because the NARF operations varied from day to day and from shift to shift. Collected information provided a basis for determining loads for single days during the survey and maximum loads to be expected from various departments.

Arrangement of Sewers

The industrial wastewaters from NARF were discharged to the pollution abatement sewers and the storm sewers, providing one way of classifying flows. The division of the NARF operations provided a second classification of flows by Air Frame and Power Plant (engine overhaul and repair) divisions. The arrangement of sewers and buildings is shown schematically in Figure 3. Buildings 137, 1280, 245, and 424 were assigned to Air Frame and buildings 133, 1690 and 3402 were assigned to Power Plant. Building 188 was used for emergency repair of aircraft.

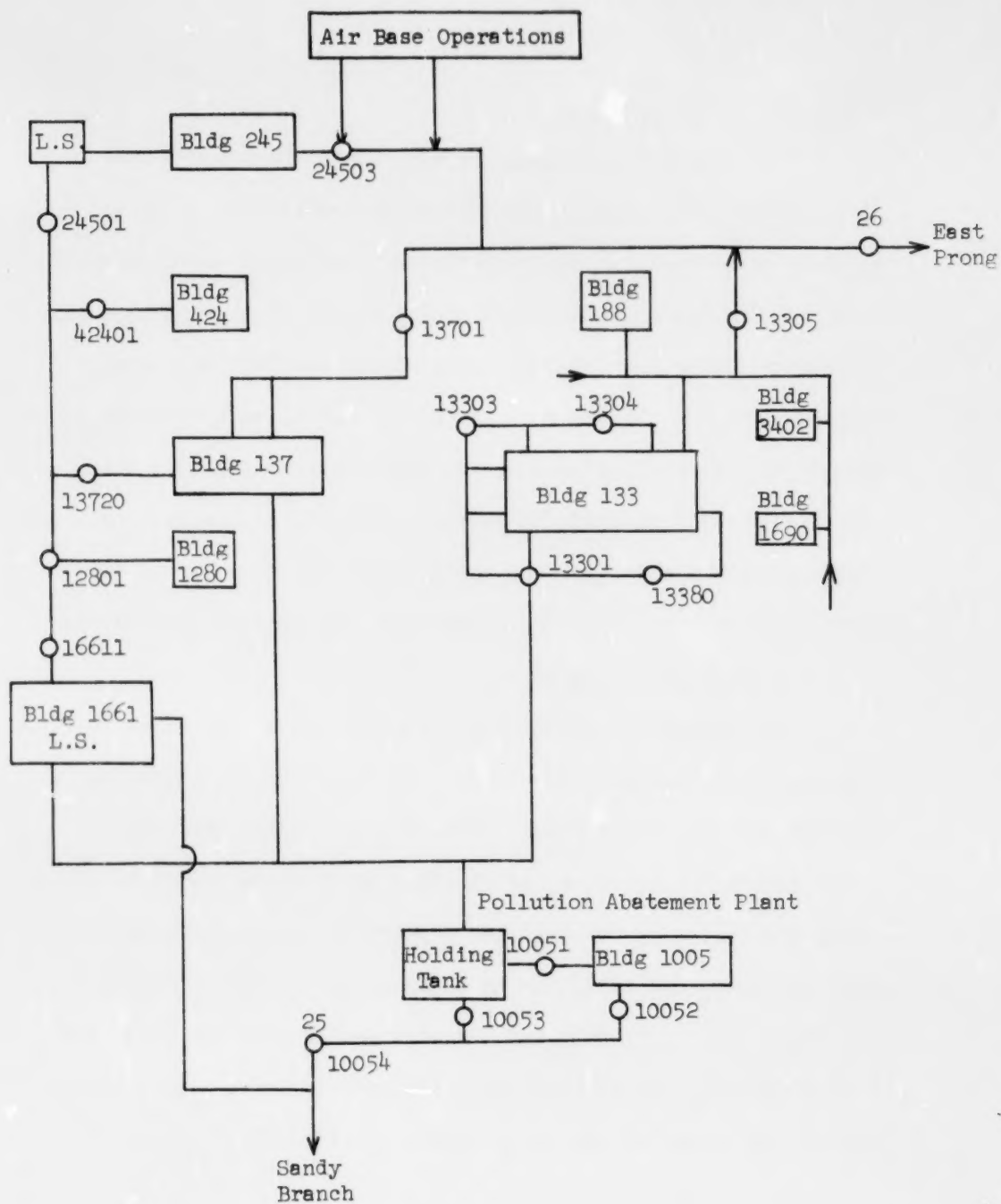


Figure 3
SCHEMATIC LOCATION OF INDUSTRIAL WASTE
SURVEY SAMPLING STATIONS

Location of Sample Stations

Pollution Abatement Sewer

The locations of sampling stations for the industrial waste survey are shown schematically in Figure 3. The wastewater from the Air Frame Division to the pollution abatement sewers, except those from Pneumatic Cleaning and Metals Examination (94404), passed through a lift station (Bldg. 1661) and were intermittently discharged to the gravity section of the pollution abatement sewer. Wastewaters were sampled in the lift station wet well (Station 16611). Wastewaters from the Power Plant Division to the pollution abatement sewer flowed by gravity through a common manhole (Sta. 13301), in front of building 133, to the Pollution Abatement Plant, being joined by the flows from the lift station. The total flow through the pollution abatement sewer was measured at a V-notch weir box (Station 25), using an integrating-recording flow meter.

Storm Sewer

Part of the wastewater from building 245 was discharged to the storm sewer through a manhole (Station 24503). Wastewaters at this station occasionally included aircraft washings from Air Base Operations, building 1664. Air Frame Division wastewaters discharged to the storm sewer, from building 137, were sampled at Station 13701 where a V-notch weir had been installed in a storm sewer ditch. In a second storm sewer ditch a V-notch weir was installed to measure the flow of wastewater from the Power Plant

Division to the storm sewer (Station 13305). These combined storm sewer flows plus any incidental drainage were sampled at a point east of Roosevelt Boulevard (Station 26).

Wastewater Flows

The integrating-recording meter flow chart was analyzed; and instantaneous rates of flow of from 35 to 245 gpm through the pollution abatement sewer and 80 to 220 gpm to the storm sewer were determined (Table 1). Rates of flow from individual pieces of equipment were measured and are presented in Appendix E. For production conditions observed during the survey, the anticipated flow for 24 hours was estimated at 222,000 gallons to the pollution abatement sewer and 164,000 gallons to the storm drain (Table 2) for certain water-using departments (Appendix E). The daily discharge of water to the pollution abatement sewer from the two divisions was compared with the total water discharged during seven days and it was found that less water was used on Wednesday than Sunday, a nonproduction day (Fig. 4). It was concluded that many flows were not shut off when the water was not needed. Plating operations were estimated to use 19 percent of the total flow, metal cleaning 40 percent, and paint stripping 10 percent (Table 3).

Sources of Pollutants

The NARF staff furnished drawings showing locations of tanks holding solutions of various chemicals. The information on these drawings and additional requested information have been consolidated in Appendix E. The information in Appendix E is summarized in Table 4 to show a chemical compound and the department in which it is used.

Table 1
OBSERVED RATES OF FLOW, gpm

Source of Wastewater	Sample Station	Maximum	Minimum ^{2/}	Nominal ^{1/}
POLLUTION ABATEMENT SEWER				
Air Frame Division except Pneumatic Cleaning and Metals Examination	16611 ^{3/}	125	10	70
Power Plant Division	13301	140	35	120
Combination of above flows	-	265	45	190
Total observed flow from Pollution Abatement Sewer	25	245	35	210
STORM SEWER				
Air Frame Division				
Cleaning Shop (93103) plus cooling water from Heat Treat Shop and Arc Welding Shop	13701	220	80	200

- ^{1/} Nominal rates of flow for first shift operations.
^{2/} Minimum rates of flow for periods of no operation.
^{3/} Inflow to lift station wet well.

Table 2. SUMMARY OF MAJOR DISCHARGE SOURCES^{1/}
(Dry Weather Flow Conditions)

SOURCE OF DISCHARGE	Flow Rate Minimum (gals/min.)	Normal Operating Flow-Average per 8 Hour Shift (gals.)	Anticipated Total Flow- 24-Hour Period (gals.)
<u>Discharges to Pollution Abatement System</u>			
16611 Lift Station	210	38,000	76,000
Pneumatics Cleaning Area (137 Building)	35	17,000	26,000
Sub Total Discharge (From 137 Area)	245	55,000	102,000
Total Wastewater Flow Station 13301	170	77,000	120,000
Total Discharge to Pollution Abatement Plant	--- ^{2/}	132,000	222,000
<u>Discharges to Storm Drainage System</u>			
Drainage to Storm Sewer At Station 13701	150	52,000	130,000
24503 Storm Sewer	40	2,000	4,000
13305 Storm Sewer	36	12,000	30,000
Total Discharge to Storm Drainage System	226	66,000	164,000
TOTAL WASTEWATER DISCHARGE	650	196,000	384,000

^{1/} Columns may not add, due to rounding of significant figures.

^{2/} If Lift Station 16611 pumping capacity is exceeded, the remaining wastewater discharge would be by-passed to the storm drainage system.

Table 3. PROCESS WATER UTILIZATION BY UNIT
PROCESSES

Number	UNIT PROCESSES	Normal Operating Flow-Average per 8 Hour Shift		Anticipated Total Flow- 24-Hour Period	
		Gallons	% of Total	Gallons	% of Total
1.	Plating				
137	Building				
	Cleaning & Paint Shop	10,000	5	30,000	8
133	Building				
	Plate & Paint Shop (Tanks 40-53)	16,000	8	16,000	4
	Plate Shop (Tanks 20-39 & 53-57)	13,000	7	17,000	4
	Plate Shop (Tanks 1-19)	<u>11,000</u>	<u>5</u>	<u>11,000</u>	<u>3</u>
	Sub-Total Plating	50,000	25	74,000	19
2.	Metal Cleaning				
137	Building				
	Pneumatics Cleaning	17,000	8	26,000	7
	Helicopter Rotor Blade	500	-	500	-
133	Building				
	Accessory Cleaning	1,900	1	1,900	-
	Engine Precleaning	1,000	1	1,000	-
	Chemical Cleaning Shop	20,000	10	59,000	16
	Examination Shop (Tanks 1-16)	9,000	5	9,000	2
	Examination Shop (Final Exam)	1,000	1	1,000	-
137	Building				
	Cleaning Shop 93103	11,000	6	26,000	7
	Washer Area 93103	3,000	1	3,000	1
	Tanks, Tubing & Surfaces Shop	<u>15,000</u>	<u>7</u>	<u>27,000</u>	<u>7</u>
	Sub-Total Metal Cleaning	79,400	40	154,400	40
3.	Paint Stripping				
424	Building				
	Aircraft Stripping	5,000	2	9,000	2
1280	Building				
	Stripping Shelter	<u>19,000</u>	<u>10</u>	<u>29,000</u>	<u>8</u>
	Sub-Total Paint Stripping	24,000	12	38,000	10

Table 3.(Cont.) PROCESS WATER UTILIZATION BY UNIT
 PROCESSES

Number	UNIT PROCESSES	Normal Operating Flow-Average per 8 Hour Shift		Anticipated Total Flow- 24-Hour Period	
		Gallons	% of Total	Gallons	% of Total
4.	Painting				
	245 Building				
	Final Finish	3,000	1	7,000	2
	133 Building				
	Plate Shop & Paint Shop	3,000	1	3,000	1
	137 Building				
	Cleaning & Paint Shop	---	---	---	---
	Sub-Total Painting	6,000	3	10,000	3
5.	Heat Treating, Welding and Related cooling waters				
	137 Building				
	Heat Treat Shop	17,000	9	50,000	13
	Arc Welding Shop	5,000	2	15,000	4
	Sub-Total Heat Treating	22,000	11	65,000	17
6.	Miscellaneous				
	133 Building				
	Jet Engine Test Cells	1,000	-	1,000	-
	Bearing Shop	---	---	---	---
	245 Building				
	East Corner Manhole	2,000	1	4,000	1
	188 Building				
	13305 Storm Sewer	1,000	1	3,000	1
	South of 133 Building	12,000	6	30,000	8
	Sub-Total Miscellaneous	16,000	8	38,000	10
	TOTAL PROCESS WATER DISCHARGE	200,000	100	380,000	100

Table 4. SOURCES OF POLLUTANTS

Related Analyses	Chemical Compound	Air Frame Division										Power Plant Division				
		Bldg	137	137	1280	424	245	137	133	133	133	133	133	133	133	133
COD	Alaphatic naptha				x	x	x	x								
	Cellulose acetate butrate				x	x	x									
	Toluene				x	x	x									
	Esters				x	x	x									
	Alcohols				x	x	x									
	Ketones				x	x	x									
	Acetone				x	x	x									
	Methyl ethyl ketone				x	x	x									
	Detergents			x	x	x	x									
	Phenols															
	Phenol			x	x	x		x								
	Methylene chloride			x	x			x								
	Trichlorethylene			x				x								
	Ortho-dichlorobenzene			x				x								
Total Oil	Varsol															
	Waste Oil															

Table 4 (Continued)

Related Analyses	Chemical Compound	Air Frame Division										Power Plant Division				
		Cleaning & Painting	Aircraft Shop	Shelter Strip	Aircraft Strip	Hangar Strip	Panel Finish	Pneumatic Clean & Exam. Shop	Test Engine	Beating Cell	Plating Shop	Engine Shop	Engine Pre-Clean	Facility Shop	Chemical Clean	Shop Examination
Bldg		137	137	1280	424	245	137	133	133	133	133	133	133	133	133	133
Specific Metals	Copper	x														
	Chromium compounds	x														
	Lead	x			x											
	Nickel	x														
	Cadmium	x														
CN	Zinc	x														
	Tin	x			x											
Total P	Cyanides	x														
	Phosphoric acid & salts	x														
CN	Sulfuric acid	x														
	Nitric acid	x														
	Other acid	x			x											
Total P	Caustic	x														
	Potassium permanganate	x														
Zyflo	Magnaflux	x														
		x														

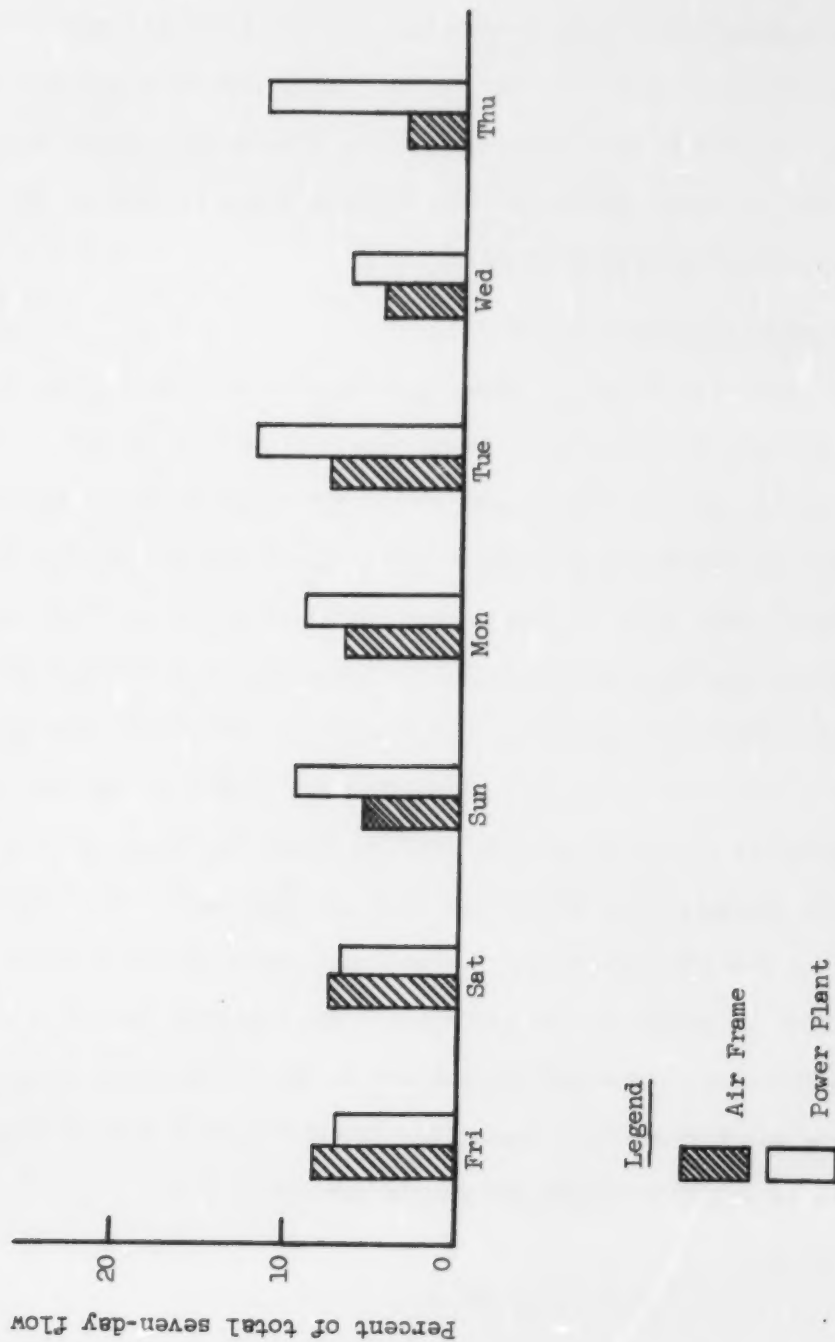


Figure 4
DISCHARGE TO POLLUTION ABATEMENT SEWER
MCAS

In the chemical analysis of the wastewaters COD is a gross determination of organic compounds, including the oils and phenol. The determination of phenol and total oil are more specific determinations. Total oil may include petroleum ether soluble organic compounds. The determination of metals and cyanide are specific for those chemicals. The determination of organic chloride is a gross determination of halocarbons.

Organic Chemicals as COD

The total amount of organic chemicals, as COD, discharged from the pollution abatement sewer (Station 25) ranged from 27 to 1100 pounds per day with a mean of 400 for six composite samples. The average discharge of organic chemicals as COD to the pollution abatement sewer from the Power Plant Division (Station 13301) was 114 pounds per day, and from the Air Frame Division (Station 16611) was 500 pounds per day with a range of 97 to 894 pounds per day. For the paint stripping operations (Station 12801) of the Air Frame Division two composite samples were collected for short periods and the concentration of COD was 2470 and 6300 mg/l. The discharge from the Final Finish Hangar to the storm drain (Station 24503) was about 14 pounds of COD per shift. The Cleaning Shop of the Air Frame Division discharged wastewaters to the storm drain along with cooling water from other operations (Station 13701) and the organic chemicals as COD averaged 220 pounds per day.

Phenol

The quantity of phenol discharged from the pollution abatement sewer (Station 25) ranged from 7.5 to 110 pounds per day with a mean of 62 for seven composite samples. The discharge of phenol from the Power Plant Division (Station 13301) was about one pound per day. The amount of phenol discharged from the Air Frame Division (Station 16611) varied from virtually none to 300 pounds in a 24-hour period. The phenol from the Air Frame Cleaning Shop (Station 13701) amounted to 18 pounds per day.

Total Oil (Ether Extractables)

The total oil discharged from the pollution abatement sewer (Station 25) was estimated to be 120 pounds per day. These samples were collected after the flutable oil had been effectively removed in the holding tank at the Pollution Abatement Plant. The concentration of oil discharged from the Power Plant Division (Station 13301) ranged from 13 mg/l to 2740 mg/l with a mean of 520 mg/l for six discrete samples. This was oil from Engine Preclean and jet fuel from the Jet Engine Test Cells. The concentration of total oil from the Air Frame Division (Station 16611) ranged from 12 to 40 mg/l with a mean of 24 mg/l for four discrete samples.

Cyanides

The maximum concentration of cyanide discharged from the pollution abatement sewer (Station 25) was 3.4 mg/l.

Metals

The principal metal discharge was the chromium from the Power Plant Division (Sta. 13301), averaging 11 pounds per day (Table 5).

Table 5. METALS, pounds per day

Station	Copper	Chromium	Lead	Nickel	Cadmium	Zinc
25	0.1	5	-	0.0	0.2	0.3
13301	0.3	11	0.1	0.0	0.2	0.2
16611	0.0-1.1	0-1	0.0	0.0	0.0	0.0-0.2

Halocarbons

Halocarbons (chlorinated hydrocarbons) reported as organic chlorine (Org.Cl⁻) were determined by gas chromatography on composite water samples and selected discrete water samples. The greater concentrations of halocarbons were observed from Engine Preclean (Sta. 13301) at 1.165 mg/l and the Aircraft Stripping Shelter (Sta. 12801) at 1.977 mg/l (Table 6).

Air Base Operations

The two principal sources of wastes from the Air Base Operations were the repair and washing of airplanes, and the disposal of contaminated fuel. Wastewaters from the repair and washing of airplanes were discharged to the storm sewer system.

Table 6. HALOCARBONS

Station	Kind	Date	Org.Cl ⁻ , mg/l
26	Comp	-	0.395
25	Comp	-	0.105
13301	Comp	-	1.912
13303	Grab	10/1	0.208
13303	Comp	9/30-10/2	1.165
13304	Comp	-	0.140
16611	Comp	-	0.288
16611	Grab	10/4	0.234
16611	Grab	10/2	0.883
12801	Grab	9/30	1.977
42401	Grab	9/30	0.317
24503	Grab	10/1	2.546
24503	Comp	9/29-30, 10/2,4,5	0.069
13701	Comp	10/3-5	0.042

Contaminated fuel was supposed to be collected, but there had been instances of discharging the material to the sanitary sewer system.

Wash racks for airplanes were provided with oil traps. These were cleaned periodically by pumping the oil into tanks and hauling the material to impoundments for burning. If these traps were allowed to overflow, the oil would appear in the storm water ditches. Frequent removal of the oil from the traps and visual observations of the ditches effectively provided control of this source of pollution. During the survey no airplanes were washed in the wash rack areas adjacent to buildings 1664 to 1667 and 131. There was evidence of oily wastes having been dumped on the ground adjacent to water-courses which provided an unsightly condition at the Air Station, and were a potential source of oil to be carried into the watercourses with runoff.

Previous to the survey the sewage treatment plant had been subjected to discharges of jet fuel. During the survey period Public Works Department personnel were investigating the sources of the jet fuel. It was reported that contaminated fuel was discharged to a slop-sink connected to the sanitary sewer system. The photographic laboratories discharging to the sanitary sewer were a potential source of complexed cyanide.

EFFECTS OF POLLUTION ON WATER QUALITY AND USES

The tabulated analyses for samples collected at sampling stations 11 through 17 are presented in Appendix D in tables D-1 through D-14.

BACTERIAL POLLUTION

Confirmed coliform and fecal coliform bacteria were determined by the multiple tube method and reported as most probable numbers (MPN) per 100 ml. The data for fecal coliform are presented in Figure 5. The range of values is indicated as well as the geometric mean. For Slocum Creek and the Prongs the MPN/100 ml of fecal coliform during the survey was less than the limits specified by North Carolina. At the mouth of Slocum Creek (Sta. 11) the bacterial density was less than that specified for the Neuse River.

For Stations 11 and 12, Tucker Creek and the mouth of Slocum Creek, the bacterial pollution was less than 200 MPN/100 ml, the limit for bathing as specified by North Carolina. At Ordinance Point (Sta. 13) within the recreational boating area for Special Services boats, the bacterial pollution was not quite low enough (200 MPN/100 ml) to have permitted bathing as a best use of the water. The effluent from the Station Sewage Treatment Plant discharged about 2500 feet above Station 13. From Table D-15, Station 19, the chlorine residual and fecal coliform in

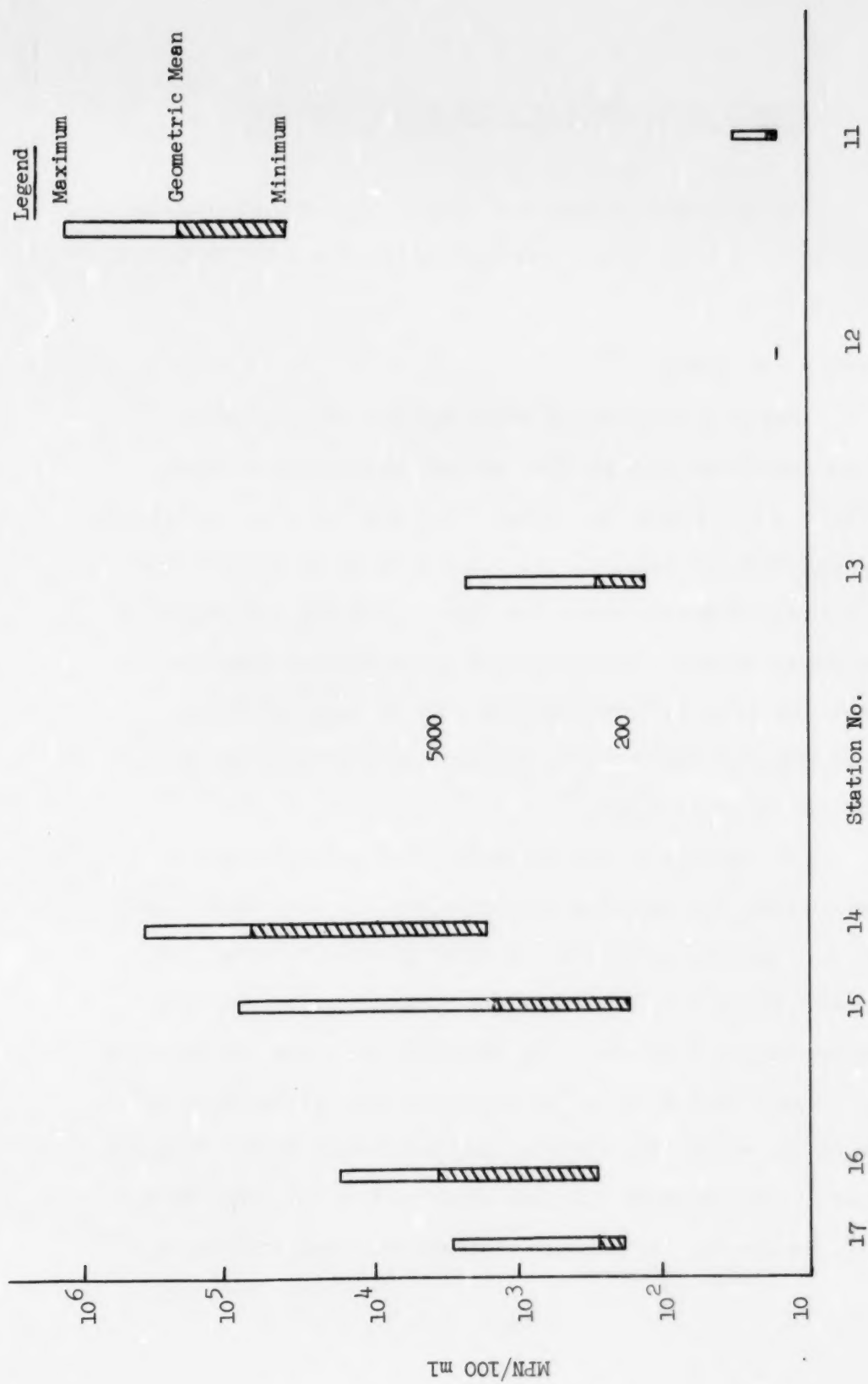


Figure 5
 FECAL COLIFORM - SLOCUM CREEK
 September 24-30, 1968, MACS

the effluent were:

Chlorine Residual mg/l	Fecal Coliform MPN/100 ml
0.5	330
1.5	170
1.0	330
0.0	160,000
2.5	50
2.0	330

These data clearly illustrate the effectiveness of chlorination in reducing bacterial pollution. They also show why North Carolina classified these waters for fishing rather than bathing; when there was no residual chlorine the bacterial pollution was hazardous, and this is common experience with chlorination of sewage treatment plant effluents.

OXYGEN DEMAND AND DISSOLVED OXYGEN

Observed values of BOD and dissolved oxygen (D.O.) for the stream stations are presented in Figures 6A and B. Samples for BOD were taken about six inches below the water surface. Samples for D.O. were collected at depths indicated in the graphical presentation. These samples were iced and then chemically fixed in the laboratory within two hours of the time of collection. The relative oxygen-demanding loads discharged to the streams during the survey and their relationship to stream sampling stations are presented in Figure 7.

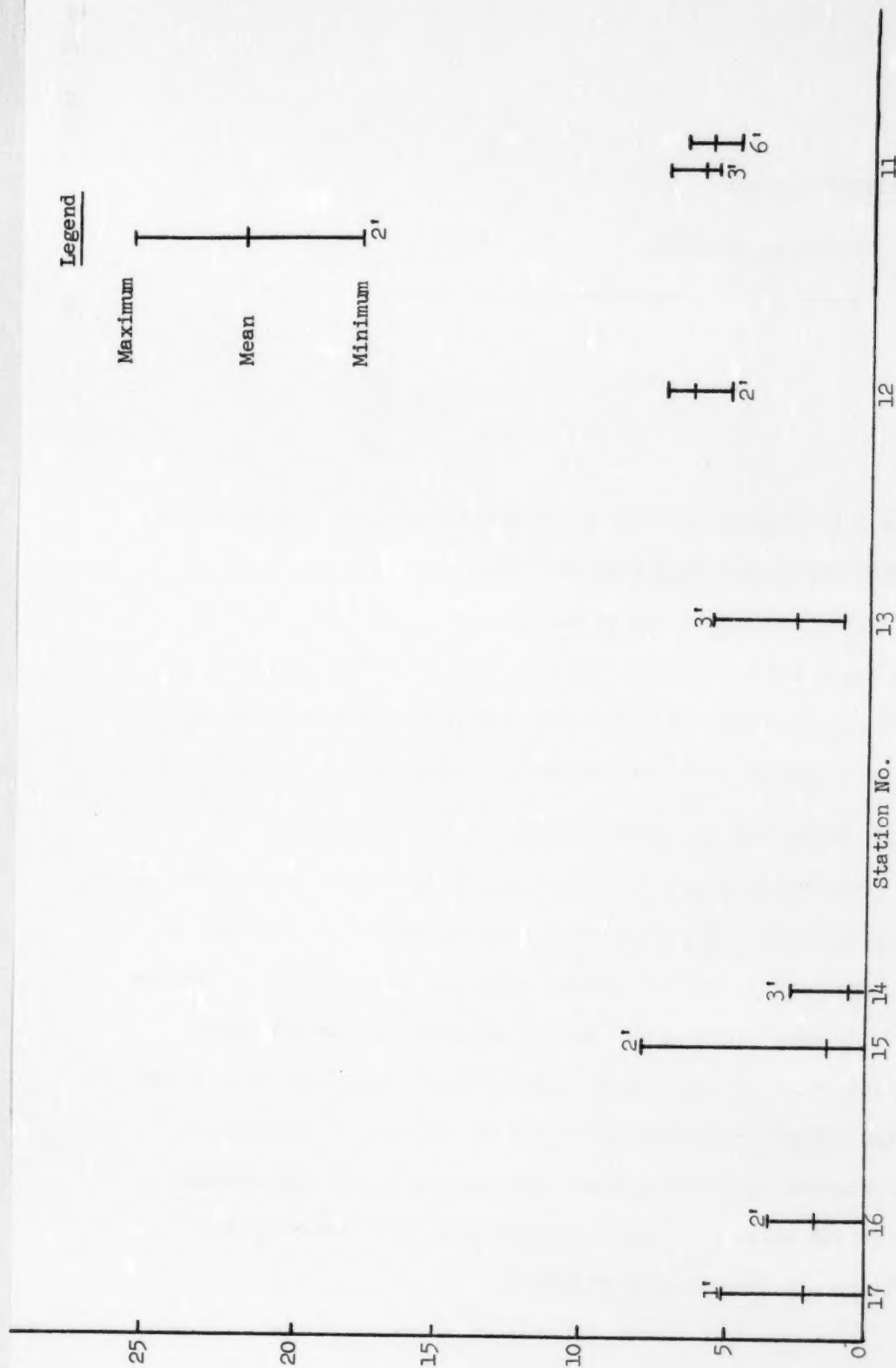


Figure 6A
D.O. IN SLOCUM CREEK
September 24-30, 1968, MCAS

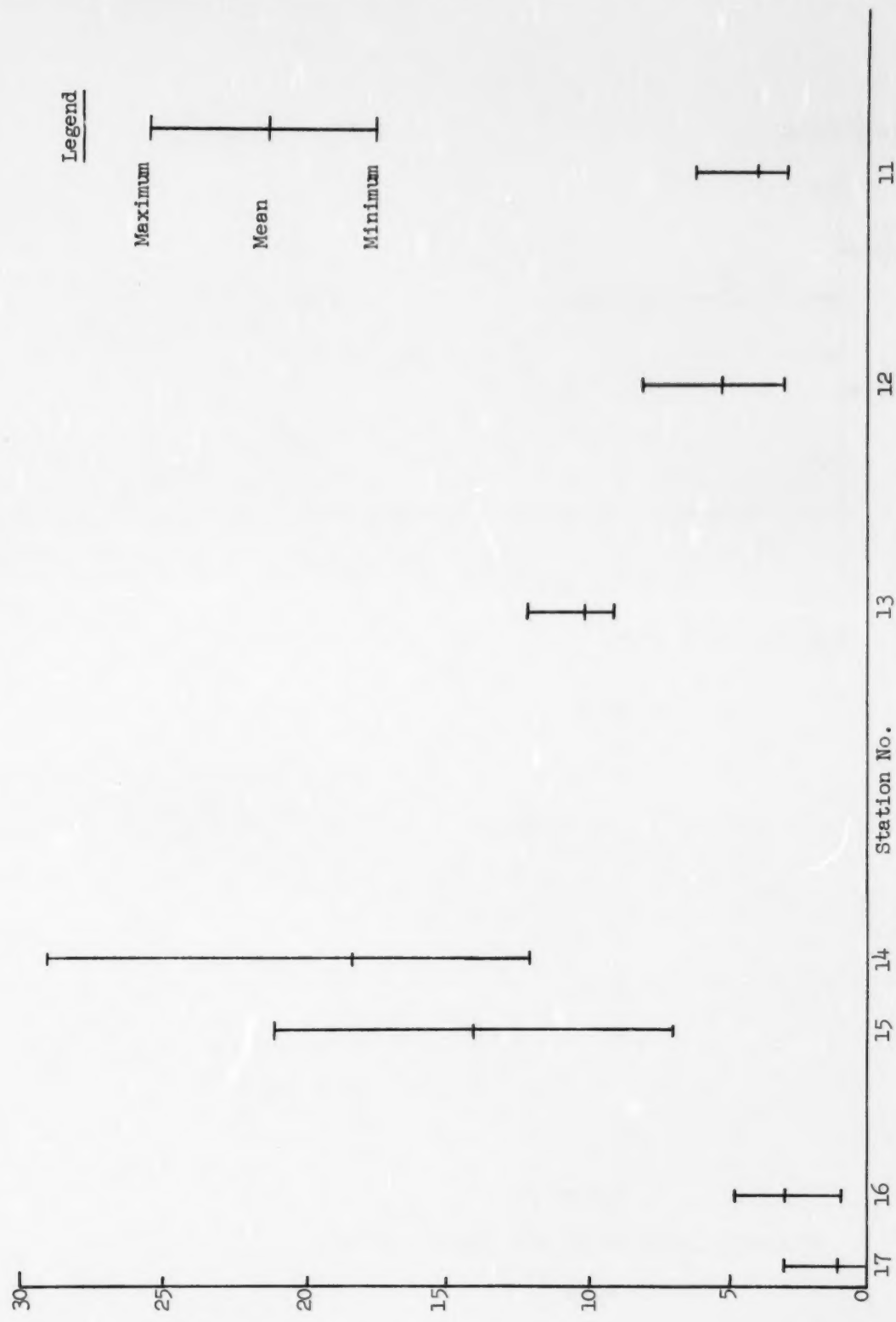


Figure 6B

BOD IN SLOCUM CREEK
September 24-30, 1968, MCAS

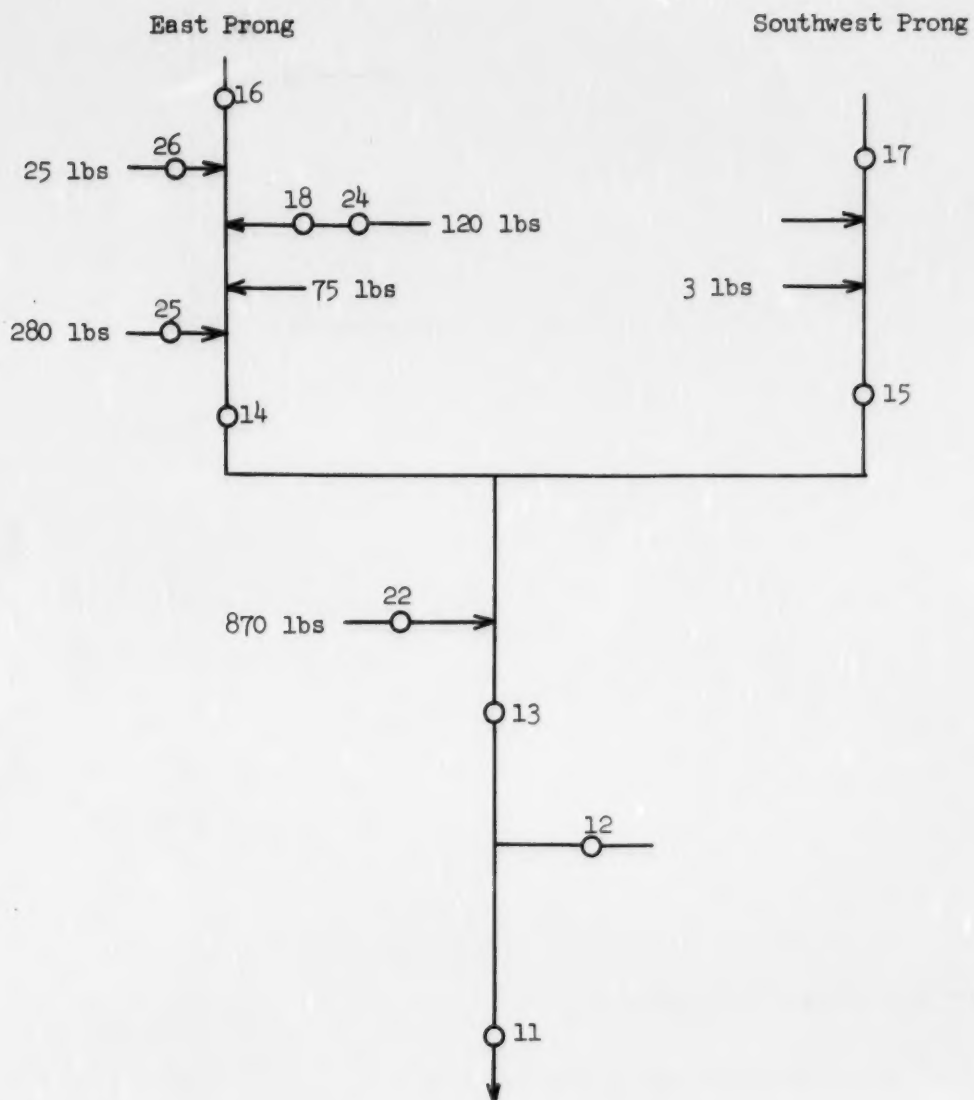


Figure 7

SCHEMATIC LOCATION OF BOD₅ LOADS, lbs/day

MCAS

Damaging amounts of oxygen-demanding material were discharged to the East Prong. The principal loads were from the Pollution Abatement Plant (Sta. 25), 280 pounds per day, and the Slocum Village Sewage Treatment Plant (Sta. 24), 120 pounds per day. This is indicated by the average concentration of 19 mg/l of BOD observed at Station 14 (Fig. 6B). Some of this load probably backed up into the Southwest Prong (Sta. 15) as confirmed by the Tracer Studies. The largest oxygen-demanding load (870 pounds per day) was from the Station Sewage Treatment Plant (Sta. 22), discharging to Slocum Creek.

The oxygen-demanding load in the water at the upstream stations (16 and 17) was negligible, but the D.O. averaged less than 3 mg/l, the lower limit specified by North Carolina. There was an undetermined oxygen demand from the swamps adjacent to the open water and the inflow to each Prong was on the order of only one CFS (cubic foot per second). There was a drought during the survey and runoff was essentially nil. The average D.O. at stations 14 and 15 was even lower, 0.5 and 1.3 mg/l, respectively, largely caused by the pollution discharged to the East Prong. At Ordinance Point (Sta. 13) below the Station Sewage Treatment Plant the average D.O. was 2.3 mg/l at the 3-foot depth. During the survey the D.O. at the mouth of Slocum Creek (Sta. 11) was well above the specified minimum of 3.0 mg/l.

During the survey schools of small fish were observed at the surface, even at stations 14 and 15, but they were not in distress. Special studies were conducted to evaluate these observances. They are fully discussed in Appendix B and the data are tabulated in Table B2. The Winkler method of determining D.O. indicated slightly lower values of D.O. than the meter used in these special studies. There was some stratification of D.O. particularly at Station 15. The reporting of fish at the surface and zero D.O. at 2 to 3-foot depths was not a contradiction.

DAMAGE TO AQUATIC LIFE

At Stations 13, 14, 15, 16 and 17, the dissolved oxygen as determined from the selected sampling depth was below the State water quality standard and, indeed, was 0.0 on some sampling dates at the latter four stations. At Station 13 it was 0.06 on September 28. These levels of D.O. would not support fish or desired fishfood organisms.

The pH was higher than the State water quality standard at Station 13 on four of the six sampling dates.

At the stream stations the phenol, cyanide, chromium, lead, nickel, and cadmium were zero during the sampling period. Copper appeared in highest concentrations near the mouth where the greatest salinity existed. The heavy metals, cyanide, and phenol were not found in concentrations that can be stated to be harmful to aquatic life within types of environments sampled.

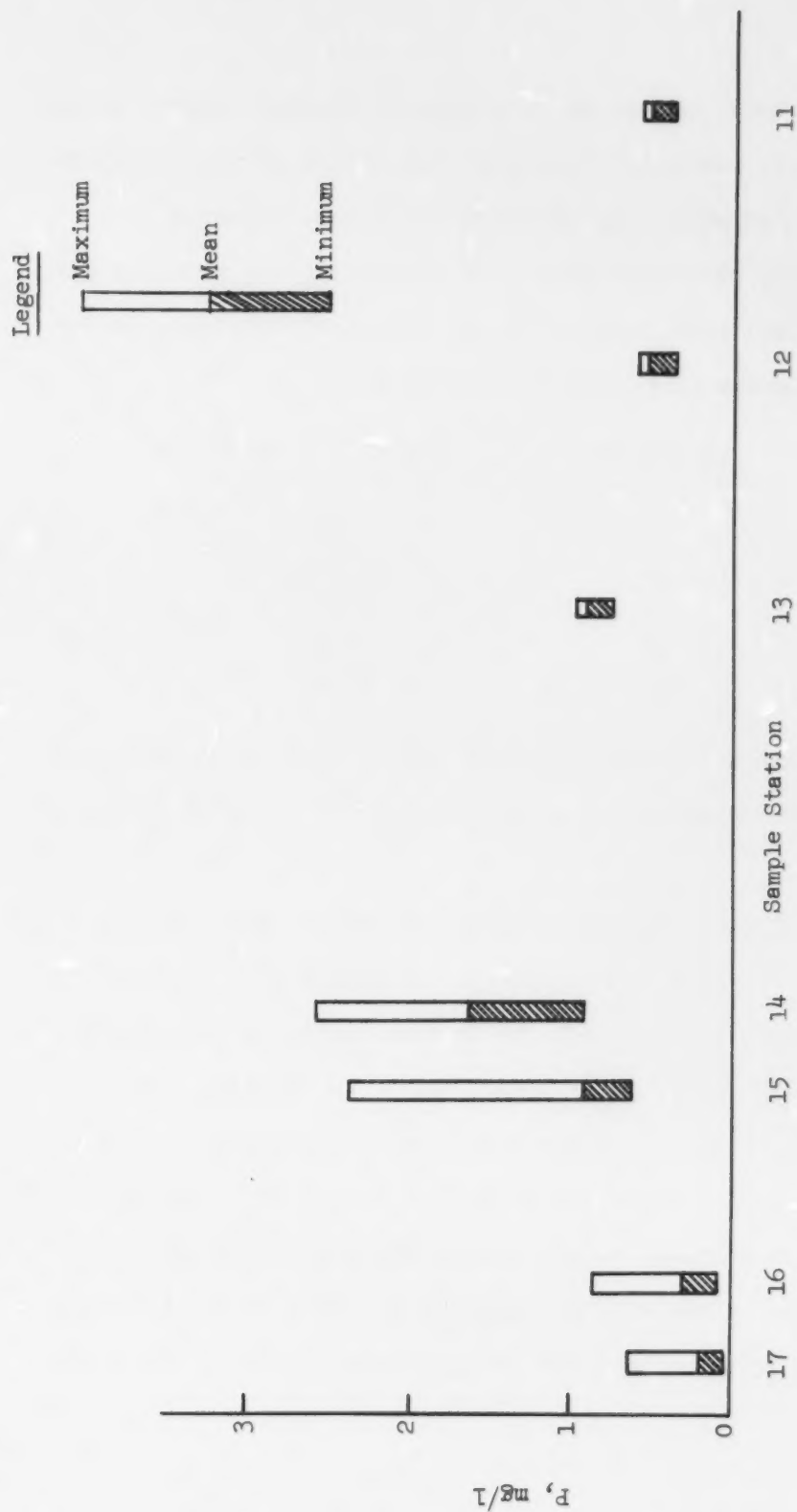


Figure 8

TOTAL PHOSPHORUS - SLOCUM CREEK
September 24-30, 1968, MACS

The total phosphorus data (Fig. 8) indicate extremely high values at all stations. This very rich environment is certainly adequate to stimulate the growth of biological nuisances.

During the stream survey water samples were collected and composited for each station. These composites were analyzed for organic chlorine with the following results:

Station No.	Organ. Cl ⁻ , mg/l
11	1.356
12	1.153
13	0.286
14	1.637
15	0.273
16	1.351
17	0.152

Some halocarbons produce undesirable taste and odor in water and they can be suspect of tainting fish flesh at these concentrations.

Results of examination of bottom samples indicate the following: On the East Prong at the railroad bridge south of Highway 101 (above Sta. 16), the benthos indicated satisfactory water quality for this particular type of environment. This station was unique; it was at a high enough elevation to have not been submerged by water backed up from Station 16. Between the discharge from Slocum Village Sewage Treatment Plant and Sandy Branch, leaf litter with no organisms was found at two stations, indicating toxic or otherwise inhospitable conditions within the

bottom sediments for aquatic life. In the Southwest Prong no organisms were found downstream from U.S. Highway 70 bridge and only 16 sludgeworms per square foot were found near Station 17. The benthic environment in this area is unsuitable for the development of most bottom-associated organisms. In the downstream stations of Slocum Creek--Ordnance Point, navigation light opposite Tucker Creek, and the mouth of Slocum Creek--the sediments were composed principally of a material that resembled leaf litter and this supported very few organisms. A type of sponge and a very few sludgeworms or marine worms were associated with the bottom habitat. About 4000 feet upstream from Station 12 on Tucker Creek the bottom sample indicated some organism diversity but was not comparable in this respect to the sample collected south of Highway 101 on the East Prong. In Tucker Creek, immature midges, marine worms and sponges were found. The bottom sediments were of similar material to those of Slocum Creek. In a number of samples on Slocum Creek and the Prongs there was an oily appearance and a smell of oil associated with the sample.

AESTHETIC CONSIDERATIONS

The polluttional material discharged to the East Prong and Slocum Creek offended the senses.

Spills of Bunker C fuel from the Electric Generating Plant coated the reedy shoreline with a black belt of oily material,

covered the beaches in recreational areas such as Ordnance Point, and reportedly stained boat hulls. Leaching oil, visible when the morning fog lifted, cast an iridescent sheen on the water's surface.

The odor of chemicals in the vicinity of Sandy Beach was unnatural to the fisherman if he should venture so far along the green waters of the East Prong. Farther upstream the odor of stale sewage permeated the air, either from the treated sewage from Slocum Village or the raw sewage from Havelock Park. Early in October 1968, with the zero runoff conditions, the East Prong became so foul that the odor of hydrogen sulfide was noticeable at the main gate to MCAS.

At the higher elevations of the East Prong and its tributaries, and tributaries to the east shore of Slocum Creek, in civilian and military areas, oil spillage had caused black blotches upon the land, to be slowly eroded into the streams.

WASTE CONTROL AND TREATMENT

PRESENT

Naval Air Rework Facility

Plating

As indicated in Appendix E there was an electroplating shop for each division with cleaning, plating, and anodizing baths and the associated rinse tanks. Plating baths were periodically checked against specification. If they were out of limits, instructions for disposal were requested from the Public Works Water Quality Laboratory.^{2/} It is reported that most of these spent baths were hauled to land disposal or salvaged.

Rinse water flow was held to a minimum for quality production, but the water ran continuously in every rinse tank, ready for instant use in job shop production.

Plating baths and rinse tanks were located over pits connected to the pollution abatement sewers. Rinse water overflowed to these pits. Any leakage from the plating baths discharged to the sewer, as was observed in Building 133 on October 2, 1968.

Metal Cleaning

Where parts were cleaned by immersion, the baths and rinses were constructed over pits, and then periodically disposed of in a

^{2/} Naval Air Rework Facility Instruction, 4121.1B, March 22, 1968.

manner similar to that reported for plating. In the Chemical Cleaning Shop, Building 133, some of the rinsing was accomplished in recirculating spray tanks. Fresh water make-up to these rinse tanks was observed to be running 24 hours per day for a single shift operation. Large parts and assemblies were cleaned over grid covered troughs and all wastes, oil, solid, and water solutions, were discharged to the sewer.

Paint Stripping

The bulk of the paint stripping operations took place in the Air Frame Division, in Buildings 1280 and 424. See Appendix E for details. Stripping compounds were applied to the surfaces and the compound and loose paint were washed off with either high pressure water jets or running water discharging from a hose. The latter practice was usually observed and it was not uncommon to see the hoses discharging on the deck. Sponges, rags, used masking material, and stripped paint were washed into the sewer.

Waste Oil

Waste oil of all kinds were to be dumped only in designated dumping places.^{2/} This practice appeared to be reasonably well controlled and continued vigilance will help to implement the program. There were oily wastes from drag-out and metal cleaning which entered the pollution abatement sewer.

Sewer Separation

Some polluted wastewaters from the Cleaning Shop in building 137 discharged to the storm sewer. Plans have been prepared to divert these wastewaters to the pollution abatement sewer.

Public Works Department

Pollution Abatement Plant

The Pollution Abatement Plant was maintained and operated by the Public Works Department to treat the wastewater generated by NARF. Uncontaminated cooling water was segregated and discharged to the storm sewer system. During the industrial waste sampling period September 30 to October 5, 1968, it was planned to operate this plant with 24-hour supervision. However, it was observed that the recording pH meter was fixed to record a pH of 7 at all times. The automatic pH control subsystem was out of order. The wastewater flow exceeded the capacity (75 gpm) of the waste pumps and the holding tank overflow bypassed the chemical treatment equipment. One of the two chemical feed pumps was out of order. This was repaired and only operated for about 24 hours. Only one waste pump was operable and this unit finally failed early in the sampling period. Thus, arrangements were made to return and operate the Pollution Abatement Plant in December. A schematic flow diagram of the plant is presented in Figure F-1.

The operation of the Pollution Abatement Plant in December 1968, is described in Appendix F. The results of various chemical dosages are summarized in Table 7.. Composite samples collected at Station 10053 during December were considered to be representative of the raw wastes, discharged from NARF to the Pollution Abatement Sewer, after the floatable oil and paint skins had been removed in the holding tank. The analyses of these composite samples are summarized in Table 8.

Table 7
RESULTS OF CHEMICAL DOSAGE

Chemicals applied	Percent Reductions			
	COD	Phenol	Total Oil	Total Cr
Air, alone	10.8	1.3	-83.9	-3.1
Air, alum and soda ash	26.8	19.7	44.9	4.2
Air, ferrous sulfate, alum, and soda ash	-8.7	8.7	58.8	42.4

Table 8

Pollution Abatement Sewer
Raw Wastes Characteristics
per 8-hour shift

	Flow gals	COD lbs	Phenol lbs	Total oil, lbs	Total Chromium, lbs.
Average	72,000	369	25.6	41	0.2
Maximum	97,000	1481	79.4	95	1
Minimum	42,000	28	0.3	2	0
No. of shifts	20	20	20	20	20

Slocum Village Sewage Treatment Plant

The percentage reduction of BOD_5 , total suspended solids, and total phosphorus averaged 66.4, 19.4, and 19.9, respectively, during the September sampling period. This is about the degree of treatment to be expected from an extended aeration plant without a final clarifier. Chlorine solution was added to the effluent pipe at a manhole. Samples were collected at the pipe discharge at the East Prong (Sta. 18). The fecal coliform averaged 8.98×10^6 MPN/100 ml. The maximum chlorine residual observed was 0.2 mg/l. Chlorination was ineffective.

Station Sewage Treatment Plant

The percentage reduction of BOD_5 , total suspended solids, and total phosphorus averaged 72.6, 67.7, and 7.7, respectively, during the September sampling survey. For the observed conditions the computed removal of BOD_5 to be expected was about 80 percent. The plant had been slugged with jet fuel sometime previous to the sampling survey. A black polymer had collected on the filter rock which probably inhibited the bacteria. Observations from early September to December indicated that the polymer was gradually disappearing. During the sampling period the total oil (ether extractables) received at the plant averaged 370 pounds per day at a mean concentration of 21 mg/l. There was a possibility that the photographic laboratories might discharge complexed cyanide

solutions to the sanitary sewer system. On only one day the concentration of cyanide in the plant influent was as high as 0.02 mg/l as CN.

A schematic flow diagram of the Station Sewage Treatment Plant, dated April 16, 1947, indicates an average design flow of 2 mgd and a maximum plant capacity of 4 mgd. These values are verified by the stated trickling filter capacity at 1400 gpm each and the indicated retention time of the primary tanks. The present Station Sewage Treatment Plant at design flows cannot be expected to provide an adequate degree of treatment for the water uses of Slocum Creek.

Town of Havelock

The sewage treatment plant for Havelock was still under construction in September. Appendix A indicates that this contact stabilization plant was to be in operation on November 5, 1968, and incentives have been provided to those individuals making connections to the sewer system within 60 days of that date. Connection to the system is mandatory.

REMEDIAL ACTION

Naval Air Rework Facility

Sewer Separation

Plans have been prepared to divert the wastewater originating in the Cleaning Shop in building 137 from the storm sewer to the

pollution abatement sewer. This change should be made. This will add about 14,000 gallons per operating shift to the pollution abatement sewer. The COD and phenol loads transferred will be on the order of 220 pounds per shift and 20 pounds per shift, respectively.

Wastewater Flows

The use of hoses for cold water washing of aircraft in the paint stripping operations and the flushing of solids to the sewer was excessive. The use of cold water jets would reduce the amount of water to be treated by about 9,000 gallons per shift.

The continuous 24-hour flow of fresh make-up water to the hot water spray rinse tanks in the Chemical Cleaning Facility Shop appears to be needless for a single shift operation. The addition of fresh water only when the sprays are operating would reduce the cost of waste treatment. It is estimated that this water use could be reduced to 10,000 gallons per operating shift.

The continuous flow of rinse water in the cleaning and plating shops adds to the cost of waste treatment. A mere tightening of the valve will not suffice. A change in the manner of rinsing will be required, either counter-current rinse tanks or spray rinse booths.

It is recommended that departmental water meters be installed and used on the process water lines for those departments listed in Table 3. A charge for waste treatment in proportion to water use would be effective in controlling the cost of waste treatment.

Paint Stripping

It is reported that aircraft paint stripping at NARF, Norfolk, Virginia, is a dry operation. Heavy paper is placed on the hangar floor and the softened paint is removed from the aircraft by hand, rather than water flushing. The solids are collected on the paper and the bundle is incinerated. If this was done at Cherry Point, it is estimated that the oxygen demand of the wastewaters would be reduced by half and the water use would be reduced by 24,000 gallons per shift.

Cleaning and Plating Baths

Tanks containing cleaning and plating baths have been constructed over pits. Spent baths have been pumped from the tanks and hauled away for salvage or land disposal. This method of pollution control was very effective during the survey and the amounts of metals and cyanides in the wastewaters were very low, to the point that damaging concentrations were not observed in the receiving waters.

There is a risk that a tank will leak and discharge to the pollution abatement sewer. In the operation of municipal sanitary sewers it is recommended that the concentration of cyanides as discharged to the sewer not exceed 2 mg/l, as CN^- . This recommendation is made for the protection of personnel working on the sewers or at sewage treatment plants, and to prevent the exposure of the

public to cyanide gases released from the sewer system. Within industrial plants, spills of cyanides should not be discharged to the sewers for distribution throughout the manufacturing area with the possibility of releasing cyanide gases and exposing personnel. Spilled solutions of heavy metals, phenols and organic solvents may interfere with biological waste treatment plants, putting them completely out of operations and severely polluting the receiving stream.

To reduce this risk, it is recommended that the floor drains in the pits be plugged and if water accumulates in the pits it would be pumped out and hauled away as a spent bath. The rinse tank overflows would have to be connected to the pollution abatement sewer.

In spent baths which are not salvaged the cyanides should be destroyed, the hexavalent chromium should be reduced to trivalent, and precipitated with the other heavy metals. This could be accomplished in a small batch treatment plant. The properly treated effluent could be discharged to the sanitary sewer and the sludges should be buried at a location where they are not subject to leaching by ground water.

Rinse Waters

Consideration was given to collecting all rinse waters and discharging them to the storm sewer after they had flowed through a monitored terminal lagoon. The selection of this method of control would require further study with regard to required piping and volumes to be collected.

Public Works Department

Pollution Abatement Plant

The removal of floatable oil and paint skimmings from the holding tank was effective and must be continued. With stringent water management it might be possible to pass all of the wastewater through the air flotation unit with 168-hour per week operation. However, with the highly fluctuating raw waste characteristics and the low observed reduction of COD, the present chemical treatment plant would not be effective in reducing the pollutional load to the receiving stream.

Electric Generating Plant

A floating boom should be placed across the cove to which the cooling water discharges. Spilled oil which drains to the cove could be skimmed and removed from the water before it spreads over Slocum Creek.

Land Disposal

Surface erosion from the land disposal area should be stopped.

Station Sewage Treatment Plant

Contaminated jet fuel had been discharged to the sanitary sewer system and has caused operating problems at the Station Sewage Treatment Plant. It was reported that oil, fuel and other floating material was periodically skimmed from the grit chamber. It was understood that oil, fuel and floating material which was mechanically

skimmed from the primary clarifiers was transferred to the digesters. When the floating material became very deep in the digester, oil may have been returned as supernatant to the sewage treatment process. With this method of operation the only way oil could be eliminated was to disperse in the sewage in the primaries and pass through the trickling filter. That which was not biologically degraded or polymerized finally discharged to Slocum Creek. It is recommended that light oils such as jet fuel which floats on the primary clarifiers be skimmed and removed from the plant site. It is anticipated that this will improve the BOD₅ reduction of the sewage treatment plant.

On some weekends both trickling filters are bypassed for draining or flooding. Only one trickling filter should be bypassed at a time. Since the greatest recreational use of Slocum Creek is on weekends, consideration should be given to the timing of filter maintenance. The filters were not bypassed on the weekend which occurred during the survey. The disinfection of the effluent must be controlled better than it was during the survey. For the protection of service personnel the average MPN/100 ml of fecal coliform should not exceed 200 for that part of Slocum Creek downstream from Slocum Bridge.

Town of Havelock

With the completion of the sanitary sewer system and sewage treatment plant in November 1968, and the mandatory connections to the sewer; waste sources within the corporate limits, including Havelock Park, the shopping center complex west of U.S. highway 70, and a mobile home park with several adjacent retail businesses, will be under control.

FUTURE

Naval Air Rework Facility

The projection of future water pollution control problems at NARF is difficult and depends on decisions beyond the scope of this report. Basically, production facilities which were operated for more than one shift in September will be expanded so that the work can be accomplished in one shift.

Wastewater Flows

In Table 9 estimated flow adjustments are presented. From these computations the future flow from NARF to the pollution abatement sewer is expected to be 170,500 gallons in an 8-hour shift. No estimate was made for the runoff from the paved area discharging to the pollution abatement sewer. Peak rates of flow were not included. In establishing a basis of design consideration should be given to the data in Tables 1 and 8.

COD

The future amount of COD is estimated to be 2,000 pounds per shift, about 1,000 pounds of BOD₅.

Phenol

The amount of phenol will probably run from 5 to 100 pounds per shift. The wastewater must not be chlorinated until the phenols are removed.

Table 9. NARF FUTURE WASTEWATER FLOWS, gallons

	Present Flows (Appendix E)		Remedial Adjustments		Revised Flows		Future Single-shift
	8-hr	24-hr	8-hr	24-hr	8-hr	24-hr	
137 Building							
Pneumatics Cleaning & Metals Examination Area	17,000	26,000	-	-	17,000	17,000	20,000
1661 Lift Station							
137 Building - Helicopter Rotor Blade Rework Shop	500	500	-	-	500	500	1,000
Cleaning & Plating Shop 93103	10,000	30,000	-	-	10,000	30,000	20,000 ^{2/}
Cleaning Shop & Washer Area 93103	14,000	(29,000) ^{1/}	+14,000	+29,000	14,000	29,000	30,000
424 Building - Aircraft Stripping Hangar	5,000	9,000	-	-	5,000	9,000	9,000
245 Building - Final Finish Hangar	3,000	7,000	+2,000	+2,000	3,000	7,000	10,000
	(2,000)	(4,000) ^{1/}			2,000	4,000	
1280 Building - Aircraft Stripping Shelter	19,000	29,000	-9,000	-18,000	10,000	11,000	20,000
133 Building							
Accessory Cleaning & Metals Examination Shop 96103	1,900	1,900	-	-	1,900	1,900	2,000
Jet Engine Test Cells	1,000	1,000	-	-	1,000	1,000	1,500
Engine Preclean	1,000	1,000	-	-	1,000	1,000	1,000
Plate Shop & Paint Shop	32,000	36,000	-	-	32,000	36,000	36,000 ^{2/}
Chemical Cleaning Facility	20,000	59,000	-10,000	-49,000	10,000	10,000	10,000
Examination Shop	10,000	10,000	-	-	10,000	10,000	10,000
					117,400	171,900	170,500

Rate of flow, gpd = 511,500

^{1/} Presently to storm drain^{2/} Rinse water could be reduced by changing rinsing equipment.

Heavy Metals

For purposes of estimating toxic concentrations chromium is estimated at five pounds per shift and other heavy metals are estimated at 0.5 pounds per shift.

Public Works Department

Plans for Proposed Industrial Waste Treatment Facility

The plans were reviewed by representatives of the Department of the Navy, MCAS, State of North Carolina, and FWPCA at the Middle Atlantic Regional Offices of FWPCA on February 4, 1969. The proposed facilities were found to be inadequate for the water pollution control needs of NARF, with regard to removal of oxygen demanding materials and compatibility with type, amount and control of industrial wastes contributed by NARF under existing and future operating procedures.

Recommended Consideration for the Treatment of NARF Wastewaters

Gravity Separators

The flatable oil and paint skins must be removed from the wastewaters. Two mechanical separators are required, each capable of hydraulically handling the maximum rate of discharge without bypassing. Together they should be able to properly remove the floating and suspended solids. The floating material must be mechanically removed from the surface to a suitable vessel for hauling to a disposal site.

Concentration Equalization and Stripping

In order to reduce the instantaneous shock loads to any subsequent biological treatment devices the wastewaters must pass through a tank or basin in which complete mixing is provided such that the concentration in any part of the tank or basin is equal to the concentration in the effluent. The total volume should be between that volume discharged in one shift and that discharged in nine shifts. The total volume may be divided between two tanks or basins operable either in series or parallel.

If these wastewaters are to be discharged to a sanitary sewer they should be stripped of volatile matter to reduce the explosion hazard. A stripping tower such as a high rate plastic media trickling filter or surface aerators may be considered. The trickling filter, of suitable material considering the potential organic chemicals, should be operated at a high recirculation and high hydraulic rate. The filter or aerators should be adequate to prevent the wastewaters from becoming anaerobic if biological action should take place. Data from this survey are inadequate for estimating the oxygen which will be consumed in this stage of treatment.

Biological Treatment

The oxygen consuming material in the wastewaters must be reduced to a low level before the treated wastes are discharged

to the East Prong or Slocum Creek. If an independent biological treatment plant is constructed for the NARF wastes it is assumed that it would discharge through Sandy Branch to the East Prong. If the equalized and stripped wastes are discharged to the sanitary sewer they may be treated at the Station Sewage Treatment Plant site and discharged to Slocum Creek. In the latter case, it is assumed that a minimum of 430,000 gallons would be available for dilution in an 8-hour shift. The average concentrations are presented in Table 10. The maximum concentrations of heavy metals in wastewaters to be biologically treated are also indicated in Table 10.

Table 10

AVERAGE CONCENTRATIONS OF NARF WASTES IN INFLUENT TO
FUTURE BIOLOGICAL TREATMENT PLANTS, mg/l

	Independent Biological Treatment Plant	Station Sewage Treatment Plant
COD	1410	400
Phenol	71	20
Total Cr	3.4	1
Other metals	0.4	0.1

Limiting concentrations of heavy metals in raw sewage^{3/}

Copper	0.4 mg/l
Chromium	> 50 mg/l as chromate
Nickel	1 mg/l
Zinc	10 mg/l

^{3/} Anon. "Interaction of Heavy Metals and Biological Sewage Treatment Processes," USPHS, Division of Water Pollution Control, Cincinnati, Ohio, May 1965.

For the independent biological treatment plant, trickling filters, variations of the activated sludge process and aerated lagoons with surface or brush aerators may be considered. The last stage of the biological treatment plant should be a holding pond with a depth variable between 3 and 5 feet and a variable nominal detention time of 3 to 10 days.

Slocum Village Sewage Treatment Plant

The effluent from this plant should be discharged through a holding pond of variable depth of 3 to 5 feet and variable detention time of 3 to 10 days. An alternate to this improvement would be to pump comminuted sewage to the MCAS sanitary sewer for treatment in the Station Sewage Treatment Plant.

Station Sewage Treatment Plant

Since additional treatment capacity is required at the existing plant, consideration should be given to also treating NARF wastewaters and comminuted sewage from Slocum Village at the Station Sewage Treatment Plant site.

Suggested Basis of Design

Total Wastewater Flows

MCAS at 2 mgd + 10%	2.2 mgd
Slocum Village at 0.22 mgd + 10%	0.24
NARF at 0.51 mgd (Table 9)	<u>0.51</u>
	2.95 mgd

Raw Sewage Load as BOD₅

MCAS (Table D-16)	5000 lbs
Slocum Village (Table D-17)	500
NARF	<u>3000</u>
	8500 lbs

Primary Effluent

MCAS at 75% remaining	3750 lbs
Slocum Village at 75% remaining	375
NARF at 100% remaining	<u>3000</u>
	7125 lbs

Terminal Holding Pond

Depth 3 to 5 feet
Detention 3 to 10 days
Loading 50 pounds BOD₅ per acre
18 acres at 50 pounds = 900 pounds

Trickling Filters and Final Clarifiers

$$\frac{7125 - 900}{7125} 100 = 87.5\% \text{ removal required}$$

Suggested Order of Construction

If an engineering evaluation indicates that for the future MCAS operations it is desirable to biologically treat the NARF and Slocum Village wastewaters at the Station Sewage Treatment Plant site, the gravity separators and equalization facilities could be constructed immediately and the NARF wastewaters could be discharged to the sanitary sewer system. The terminal holding pond could be constructed immediately. Plans could be

prepared for the future addition to the secondary treatment facilities at the Station Sewage Treatment Plant site and financing could be arranged so that this enlargement could be completed as the NARF expansion takes place, and the Slocum Village sewage could be pumped to the MCAS sanitary sewers.

Minimum Costs

The Department of the Navy should make feasibility studies to minimize the production costs in NARF departments which use process water and minimize the cost of treating the wastewaters from these departments to the degree required for the best use of the waters of Slocum Creek and its tributaries. The alternate methods of control and treatment to be considered are presented in Figure 9.

Town of Havelock

It is suggested that the effluent from the sewage treatment plant for the Town of Havelock be discharged through a holding pond to the East Prong.

[illegible]

Figure 9. ALTERNATE METHODS OF CONTROL AND TREATMENT
MCAS





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